ELECTRICAL APPRENTICESHIP CURRICULUM OUTLINE FY2012
YEAR 4

Electrical Training: **162 hours**

First Semester & Yearly Final Exams: **6 hours**

Total Hours: **168 hours**

Each of the following subjects may take more or less time than is shown, but a minimum of 144 hours is required. The instructor should concentrate on the student achieving the basic objectives stated. This course of study should be backed up by a number of worksheets, quizzes, and exams covering the entire code and not just the subjects at hand. The instructor should add strategic safety questions based on NFPA 70E and general safety from time to time. This course should be based in a "learn by doing" strategy.

Recommended Textbooks for PTE Schools:

Mike Holt Illustrated Guide Understanding NEC 2011 Vol 1 Text ISBN 978-1-932685-51-0
& Workbook, ISBN 978-1-932685-70-1
Mike Holt Illustrated Guide Understanding NEC 2011 Vol 2 Text, ISBN 978-1-932685-59-6
NFPA 70: National Electric Code 2011, ISBN 978-087765914-3
Ugly's Electrical Safety and NEPA 70E, ISBN 978-0-7637-6855-3.

Hazardous Locations: Articles 500 through 504

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine proper wiring of a Class I, Division 1 locations
- Determine proper wiring of a Class I, Division 2 locations
- Determine proper wiring of a Class II, Division 1 locations
- Determine proper wiring of a Class II, Division 2 locations
- Determine proper wiring of a Class III, Division 1 locations
- Determine proper wiring of a Class III, Division 2 locations
- Determine proper wiring of Commercial Garages
- Determine proper wiring of Motor Fuel Dispensing Facilities

Commercial Garages, Motor Fuel Dispensing Facilities: Articles 511 and 514

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define a major repair garage
- Define a minor repair garage
- Properly classify hazardous areas
- Use the NEC to properly wire a commercial garage of any type
- Define a Motor Fuel Dispensing Facility
- Use the NEC to properly wire Motor Fuel Dispensing Facilities

Health Care Facilities, Assembly Occupancies, Carnivals, Fairs and Similar Events: Articles 517 through 525

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Use the NEC to properly define a health care facility type
- Define General Care Areas and Critical Care Areas
- Discuss Essential Electrical Systems
- Properly wire and ground a health care facility
- Discuss the proper wiring methods for places of assembly
- Discuss the proper wiring of carnivals, fairs, and similar events

Agricultural Buildings, Marinas and Boatyards, Temporary Installations: Articles 547 through 590

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine the proper wiring for any agricultural building
- Properly calculate farm loads using the NEC
- Determine marina requirements using the NEC
- Determine and discuss the requirements for temporary installations

Electric Signs and Outline Lighting, Manufactured Wiring Systems, Elevators, Escalators, and Moving Walks: Articles 600 through 620

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine proper installation and requirements of electric signs and associated lighting
- Compare manufactured wiring systems instructions against Article 604 or 605 as is appropriate
- Determine proper installation and requirements of elevators, escalators, and moving walks

Audio Signal Processing, Amplification, Reproduction Equipment, and Information Technology Equipment: Articles 640 and 645

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Apply the goal of reducing the spread of fire and smoke in case of a fire
- Comply with other articles when installing audio equipment
- Reduce shock hazards peculiar to audio equipment
- Determine proper installations in IT rooms

Swimming Pools, Spas, Hot Tubs, Fountains, and Similar Locations: Article 680

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine proper electrical installations for swimming pools
- Determine proper electrical installations for spas and hot tubs
- Determine proper electrical installations for fountains

Emergency Standby Power Systems, Legally Required Power Systems, Optional Standby Power Systems: Articles 700 through 702

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the proper installation of systems deemed essential to protect human life
- Determine the difference between *emergency* stand by, *legally required* standby, and *optional standby* power systems

Remote-Control, Signaling, and Power-Limited Circuits: Article 725

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Define a class 1 circuit
- Define a class 2 circuit
- Define a class 3 circuit
- Determine proper installation and requirements class 1, class 2, and class 3 circuits

Fire Alarm Systems: Article 760

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define nonpower-limited fire alarm circuits
- Define power-limited fire alarm circuits
- Determine the proper installation of fire alarm wiring using the NEC
- Determine where the use of GFCI and AFCI are restricted
- Determine environmental air space

Optical Fiber Cables and Raceways, Communications Systems: Articles 770 and 800 through 820

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine proper installation of optical fiber cables
- Properly fire-stop penetrations
- Determine proper grounding of communications wiring and equipment
- Determine proper installations of communication wiring

Requirement for Electrical Installations: Article 110

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the proper termination of conductors
- Determine the kinds of warnings, markings, and identification a given installation requires
- Determine the proper working clearance for any installation
- Determine proper voltage rating
- Determine proper AIC rating

Use and Identification of Grounded Conductors, Branch Circuits, Feeders: Articles 200, 210 and 215

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Properly identify a grounded conductor
- Properly apply the general provisions of Article 210
- Properly apply the branch circuits ratings of Article 210
- Properly install the required outlets of Article 210
- Calculate the minimum size and ampacity of any feeder

Branch Circuit, Feeder, and Service Calculations (review from previous years): Article 220

Objectives: 12 hours

At the completion of this lesson the student should be able to use the NEC to:

- Demonstrate the ability to calculate the loads for a single family dwelling
- Demonstrate the ability to calculate the loads for a multifamily dwelling
- Demonstrate the ability to calculate the loads for a commercial or industrial installation

Outside Branch Circuits and Feeders, Services (review from previous years): Articles 225 and 230

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Properly install conductors and lighting installed outdoors
- Determine vertical and horizontal clearance of overhead conductors
- Determine proper disconnecting means and installation
- Determine the proper installation and protection of “line” and “load” conductors

Overcurrent Protection (critical review from previous years): Article 240

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Properly size a standard overcurrent device to any conductor
- Properly apply the small conductor rules
- Calculate transformer secondary conductor protection
- Reference requirements for appliance protection
- Calculate tap conductor protection
- Reference protection for motors and air conditioners

Grounding and Bonding (critical review from previous years): Article 250

Objectives: 12 hours

At the completion of this lesson the student should be able to use the NEC to:

- Define the difference between grounding and bonding
- Determine the proper grounding and bonding requirements of any system
- Properly size the main bonding jumper
- Properly size the grounding electrode conductor
- Properly size equipment grounding conductors
- Determine the various types of a grounding conductors
- Design a proper grounding electrode system

Surge Protective Devices: Article 285

Objectives: 1.5 hours

At the completion of this lesson the student should be able to:

- Determine the installation requirements SPD's
- Discuss the difference between Type 1, Type 2, and Type 3 SPD's and their use

Wiring Methods, Conductors for General Wiring: Articles 300 and 310

Objectives: 12 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine how to route, splice, protect, and secure conductors and raceways
- Determine the general requirements for conductors such as insulation markings, ampacity ratings, and conductors to use in specific installations
- Properly use the Article 310 tables
- Apply Chapter 9 tables
- Properly derate any conductor based on wire fill, temperature, and continuous load
- Define the meaning of conductor insulation lettering
- Discuss the effects of nonlinear loads on multiwire branch circuit and feeder neutral conductors and if a neutral conductor is to be counted as current carrying.

Cabinets, Cutout Boxes, and Meter Socket Enclosures; Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Handhole Enclosures: Articles 312 and 314

Objectives: 9 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the use of any enclosure based on the conditions of use
- Determine the installation requirements for any enclosure
- Properly use boxes and fittings based on internal volume
- Determine the requirements for fill of boxes and fittings

- Properly size pull and junction boxes for No. 4 AWG conductors and larger

Armored Cable, Metal Clad Cable, Nonmetallic-Sheathed Cable, Service-Entrance Cable, Underground Feeder and Branch-Circuit Cable (Type UF): Articles 320, 330, 334, 338, and 340

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the installation requirements of Armored Cable
- Determine the installation requirements of Metal-Clad Cable
- Determine the installation requirements of Nonmetallic-Sheathed Cable
- Determine the installation requirements of Service-Entrance Cable
- Determine the installation requirements of Underground Feeder and Branch-Circuit Cable (Type UF)
- Relate temperature concerns, derating, etc. to other appropriate articles in the NEC

Intermediate Metal Conduit, Ridged Metal Conduit, Flexible Metal Conduit, Liquidtight Flexible Metal Conduit: Articles 342, 344, 348, and 350

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the installation requirements of Intermediate Metal conduit
- Determine the installation requirements of Ridged Metal Conduit
- Determine the installation requirements of Flexible Metal Conduit
- Determine the installation requirements of Liquidtight Flexible Metal Conduit
- Relate conductor fill, derating, etc. to other appropriate articles in the NEC

Ridged Polyvinyl Chloride Conduit, Liquidtight Flexible Nonmetallic Conduit, Electrical Metallic Tubing, Electrical Nonmetallic Tubing: Articles 352, 356, 358, and 362

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the installation requirements of Ridged Polyvinyl Chloride Conduit
- Determine the installation requirements of Liquidtight Flexible Nonmetallic Conduit
- Determine the installation requirements of Electrical Metallic Tubing
- Determine the installation requirements of Electrical Nonmetallic Tubing
- Relate conductor fill, derating, etc. to other appropriate articles in the NEC

Metal Wireways, Multioutlet Assemblies, Surface Metal Raceways, Cable Trays: Articles 376, 380, 386, 392

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the proper installation of a metal wireway
- Calculate the proper conductor fill of a metal wireway
- Calculate the proper size of a metal wireway based on conductor size and conduit entries
- Properly splice conductors in a metal wireway
- Determine the proper installation of multioutlet assemblies
- Determine the proper installation of surface metal raceways
- Determine the proper installation and use of cable trays

Flexible Cords and Flexible Cables, Fixture Wires, Switches, Receptacles, Cord Connectors, and Attachment Plugs: Articles 400, 402, 404, and 406

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Identify requirements, applications, and construction specifications of cords and cables
- Select cords, cables, and fittings listed for specific applications
- Identify requirements and specifications of fixture wires
- Determine types and uses of switches
- Mount receptacles according to the details of 406.4 (A) through (G)
- Following the grounding requirements of the specific device being used

Switchboards and Panelboards, Luminaires, Lampholders, and Lamps: Articles 408 and 410

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the specific requirements for switchboards, panelboards, and distribution boards that control power and lighting circuits
- Properly identify the use of each circuit in a panelboard or switchboard
- Properly terminate conductors in panelboards and switchboards
- Determine the general requirements of Part I of Art. 410
- Determine the location requirements of Part II of Art. 410
- Determine the box and covers requirements of Part III of Art. 410
- Determine the support requirements of Part IV of Art. 410
- Determine the grounding requirements of Part V of Art. 410
- Determine the wiring requirements of Part VI of Art. 410

Lighting Systems Operating at 30 Volts or Less: Article 411

Objectives: 1.5 hours

At the completion of this lesson the student should be able to use the NEC to:

- Explain the potential for fire in low voltage lighting systems because of currents as high as 25 amps
- Explain the need for an isolation transformer
- Discuss the proper wiring method for low voltage lighting

Appliances, Fixed Electric Space Heating Equipment: Articles 422 and 424

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Calculate and determine proper branch circuit ratings for any appliance
- Calculate and determine proper overcurrent protection for any appliance
- Determine the requirements for nonmotor appliances
- Explain article 430 compliance for motor operated appliances
- Explain article 440 compliance for appliances containing hermetic compressors
- Determine proper disconnecting means
- Determine requirements for heating installations using Article 424, Part I through Part VI
- Understand the content of Article 424, Part VII through IX

Motors, Motor Circuits, and Controllers; Air-conditioning and Refrigeration Equipment, Articles 430 and 440 (review from previous years)

Objectives: 12 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the proper conductor size for any motor
- Determine the proper overcurrent protection for any motor
- Explain why the apparent over-fusing of conductors according to table 430.52 is both safe and necessary
- Determine the proper disconnect for any motor
- Determine the proper overload protection for any motor and condition (easy start, hard start, etc.)
- Determine the minimum size feeder for a group of motors
- Determine the feeder overcurrent protection
- Properly size circuits and overcurrent devices for air conditioning and refrigeration equipment
- Determine the requirements for the disconnecting means of refrigeration equipment